COUNTER / TIMER

INSTRUCTION MANUAL

SD 7014
20 MHz Counter

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SD 7014

20 MHz Counter

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TABLE OF CONTENTS

		Page
CHAPTER 1	GENERAL DESCRIPTION	
1.1	Basic Functions	1-1
1.2	Standard Features	1-1
1.3	Applications	1-2
1.4	Optional Features	1-2
1.5	Specifications	1-3
1.6	Recommended Test Equipment	1-6
1.7	Preparation for Reshipment	1-6
CHAPTER 2	INSTALLATION	
2.1	Installation Requirments	2-1
2.2	Inspection and Adjustment	2-1
CHAPTER 3	OPERATION	
3.1	Preparation for Use	3-1
3.2	Controls, Indicaotrs, and Connectors	3-1
3.2.1	Recycle Rate Control	3-1
3.2.2	Gate Indicator	3-1
3.2.3	Function Switch	3-1
3.2.4	Readout Indicators	3-2
3.2.5	Input Attenuator	3-2
3.2.6	Trigger Level Control	3-2
3.2.7	Annunciator Assembly	3-2
3.2.8	AC-AC Switch	3-2
3.2.9	Input Connector	3-3
3.2.10	Reset Pushbutton	3-3
3.2.11	115v/230v Line Switch	3-3
3.2.12	Storage On/Off Switch	3-3
3.2.13	Input Connector	3-3
3.2.14	Reset Connector	3-3
3.2.15	BCD OUTPUT Connector	3-3
3.2.16	Norm/Tim Switch	3-3
3.2.17	Int-Ext One MHz Switch	3-4
3.2.18	Freq. Adj.	3-4
3.3	Accuracy of Measurement	3-4
3.3.1	Oscillator Stability	3-4
3.3.2	Gating Error	3-5
3.3.3	Count Error Produced by Noise in Frequency Measurements	3-6
3.3.4	Loading Error	3-7
3.3.5	Trigger Error	3-8
3.4	Equipment Operation	3-9
3.4.1	Test Function	3-10
3.4.2	Frequency (RATE) Measurement	3-11
3.4.3	Count (Totalize) Measurements	3-12
3.4.4	Hold Function	3-12

CHAPTER 1 GENERAL DESCRIPTION

1.1 BASIC FUNCTIONS

The SD 7014 20 MHz Counter is a light weight, rugged, portable frequency counter. Simplicity of design and integrated circuit construction insure the highest reliability.

The SD 7014 is a solid-State instrument eminently capable of performing a wide range of counting and timing measurements. It has six basic measuring modes: Rate (frequency), Count (totalize), Hold, Time Interval (Start-Stop), Period (single or multiple), and Ratio (f_1/f_2).

1.2 STANDARD FEATURES

Simple, reliable, accurate operation and easy maintenance are hallmarks of the SD 7014. Its circuitry, completely solid-state, is constructed on printed circuit plug-in modules. Test points are color coded and functionally placed for troubleshooting. The seven digit in-line readout displays an answer continuously until the end of the next measurement cycle.

Automatic decimal and units-of-measure indications are provided for all rate and period measurements. The time base crystal oscillator has a stability of better than 2×10^{-6}/month. Ths oscillator's stability combined with the variable display time of the seven digit readout results in excellent readability and accuracy.

1.3 APPLICATIONS

The SD 7014 can be employed in the measurement, analysis, and counting of both periodic and random signal pulses of arbitrary waveshape within the rated frequency characteristics of the instrument. Because it operates directly from voltage inputs, it is an invaluable tool for the designing, manufacturing, and testing of instruments and circuits having an electrical output related to time interval, frequency, and number of occurances. It is commonly used for the design and calibration of transmitting and receiving equipment, tuned circuits, and crystals. Other common applications are calibration of resolvers and synchros, and the measurement of gain-phase characteristics of closed loop servo systems.

When employed with suitable input transducers (photo cells, magnetic pickups, or switches), the SD 7014 becomes equally valuable for measuring physical events with respect to time; for example: Speed of rotation, flow rate, or production unit counting.

1.4 OPTIONAL FEATURES

A variety of optional features are available to adapt the SD 7014 to many custom requirements. Options include 1-2-4-8 BCD Digital output (suitable for driving digital printers), a heated crystal, extra readout tubes (to nine maximum), and a selection of high-stability oscillators. See Chapter 1.5, Specifications, for more detailed optional features information.

1.5 SPECIFICATIONS

FREQUENCY MEASUREMENTS

Range:	0 to 20 MHz (DC input); 10 Hz to 20 MHz (AC input).
Input:	10 mV sensitivity; 1 MΩ/50 pF. 10 Hz to 12.5 MHz and increasing to 60 MV at 20 MC
Gate Time:	.01, 0.1, 1, 10 seconds
Accuracy:	±1 count ±time-base accuracy
Reads In:	kHz or MHz with positioned decimal
Self Check:	Counts 1 MHz for gate time selected.
Readout:	7 digits in-line

PERIOD AVERAGE MEASUREMENTS

Range:	Single or Multiple Period. 0 to 5 MHz.
Periods Averaged:	1 to 10^5 periods in decade steps.
Accuracy:	±1 count ±time-base accuracy ±trigger error. Trigger error is less than ±0.3% of one period ÷ periods averaged for signals with 40db or better signal-to-noise ratio.
Sensitivity:	100 mV from DC to 1 kHz; 10 mV from 1 kHz to 5 MHz.
Frequency Counted:	1 MHz
Reads In:	µS with positioned decimal point

TIME INTERVAL MEASUREMENTS

Range:	10 µS to 10 sec
Inputs (on rear panel):	Contact closure or saturated NPN transistor to ground. Signal duration: ≥1 µS. Current sinking: ≥2 mA. The START signal must end before the STOP signal begins. Time from STOP to next START: not less than 30 ms for external reset, or not less than 30 ms + sample time for internal reset.
Frequency Counted:	1 MHz internal time base of external frequency standard.

Readout:	µS with positioned decimal point.

RATIO MEASUREMENT

Displays:	(f_1/f_2) X period multiplier; Multipliers: 1, 10, 10^2, 10^3, 10^4, 10^5.
Range, Sensitivity:	f_1: 1 kHz to 2 MHz into external time-base BNC connector, 1V rms minimum into 1000Ω. f_2: 0 to 5 MHz. 10 mV sensitivity except 100 mV below 1 kHz.
Accuracy:	±1 count of f_1 ±trigger error of f_2. See Trigger Error note under Period Average Measurements (above).
Readout (legend and decimal):	Indicating but not applicable.

TIME BASE

Crystal Frequency:	1 MHz
Stability:	
Aging Rage:	Better than 2 parts in 10^6/month.
Temperature:	Less than 1 part in 10^5 from +15°C to +35°C; less than 3 parts in 10^5 from 0° C to +50° C.
Line Voltage:	Less than 1 part in 10^6 for ±10% change.
Output Frequency:	1 MHz, 3 V p-p minimum open circuit; Source impedance 2000Ω maximum.
External Input:	1 kHz to 2 MHz sine wave, 1 V rms into 1000Ω 10 V rms maximum.

GENERAL

Registration:	7 digits in-line with options to 9.
Display Storage:	Provides a continuous display of the most recent measurement. Switch on rear panel overrides storage.
Sample Rate:	0.2 s to 5 s independent of gate time, or HOLD until manual reset.

Reset:	Manual pushbutton or remote contact closure, or saturated NPN transistor to ground through rear-panel BNC connector.
Operating Temperature Range:	0°C to +50°C.
Signal Sensitivity:	Front and Rear inputs, 10 mV rms; except 100 mV rms max. 0 to 1 kHz for period, ratio measurements. 60 mv for 20 MHz frequency measure
Coupling:	AC or DC, switch selectable.
Attenuation:	Step attenuator with factors of 1, 10 and 100.
Input Level:	±1 volt times attenuation factor. A "preset" position of the Trigger Level control automatically centers trigger level at 0 volt.
Overload Without Damage:	75 V peak on X1, 200 V peak on X10, 300V peak on X100 attenuator setting.
Dimensions:	5 1/4" high by 10 1/4" wide by 15" deep.
Weight:	13 pounds net; 15 pounds shipping.
Power:	115 V/220 V ±10%, 50 to 400 Hz.

OPTIONAL FEATURES

Designation:	
B	High-Stability Oscillator. Aging rate less than 1 part in 10^9 per 24 hours.
B3	Medium-Stability Oscillator. Aging rate less than 3 parts in 10^9 per 24 hours.
B4	Super-High-Stability Oscillator. Aging rate less than 5 parts in 10^{10} per 24 hours.
D3	1-2-4-8 BCD Digital Output: 1 = +3.5V (open circuit); 0 = 0V (nominal). Source impedance 5.7 KΩ. Print command: step from 0V to +5V. Inhibit: 0V inhibits, +10 V operates.
E	Addition of extra readout digits (to 9 maximum).
XTL	Heated Crystal. Aging rate less than 3 parts in 10^7 per week.

1.6 RECOMMENDED TEST EQUIPMENT

Table 1 lists the equipment and publications required to troubleshoot, operate, and calibrate the SD 7014. Substitution of equivalent test equipment for those listed below is acceptable.

TABLE 1

RECOMMENDED TEST EQUIPMENT

QUANTITY	DESCRIPTION	NOMENCLATURE	REQUIRED USE
1	Oscilloscope	Tektronix Model 581	Troubleshooting and Calibration
1	Plug-in Unit	Tektronix Model 82	Troubleshooting and Calibration
1	One MHz Frequency Standard	1 part in 10^{10} short term stability *	Troubleshooting and calibration
1	Instruction Manual (SD 7014)		Operating instructions for SD 7014
1	EIR Voltmeter		Troubleshooting and Calibration
1	Test Oscillator	HP 651-B	Troubleshooting
1	Signal Generator	HP 675-A	Troubleshooting and Calibration
1	Coaxial Jumper Cable	50 ohms	Troubleshooting and calibration

* 1 part in 10^{7} short term is acceptable for the standard SD 7014 oscillator.

1.7 PREPARATION FOR RESHIPMENT

Should reshipment become necessary, contact the nearest Systron-Donner field office for shipping instructions. If possible, use the

original packaging materials or repack in accordance with MIL-P-116 and MIL-E-1755E. Systron-Donner field offices can provide materials similar to those used for original factory packaging. All correspondence should refer to the full nomenclature and serial number of the instrument involved.

CHAPTER 2 INSTALLATION

2.1 INSTALLATION REQUIREMENTS

The SD 7014 has no special installation requirements. It is good practice, however, to make sure the 115V/230V LINE switch setting and the ac power source are the same, to install the unit as far from heat-producing equipment as possible, and to avoid exceeding the operational limits of the counter.

2.2 INSPECTION AND ADJUSTMENT

As soon as the instrument is received, verify that it is intact and as ordered. If shipping damage of any nature is found, refer to the Warranty (inside back cover) and to Paragraph 1.7 for repackaging and shipping instructions.

An overall functional test should be performed as soon as the instrument is received. All internal adjustments are initially aligned at the factory; the instrument should be ready for use as received. Should the instrument fail to function properly or fail to meet specifications, contact your Systron-Donner representative.

CHAPTER 3 OPERATION

3.1 PREPARATION FOR USE

Make sure the POWER ON/OFF switch is OFF. Determine that the 115v/230v LINE VOLTAGE switch is in the correct position. Connect the SD 7014 to the ac power source.

3.2 CONTROLS, INDICATORS, AND CONNECTORS

Figures 1 and 2 show the location of all controls, indicators, and connectors. The following paragraphs present their functional descriptions:

FRONT PANEL

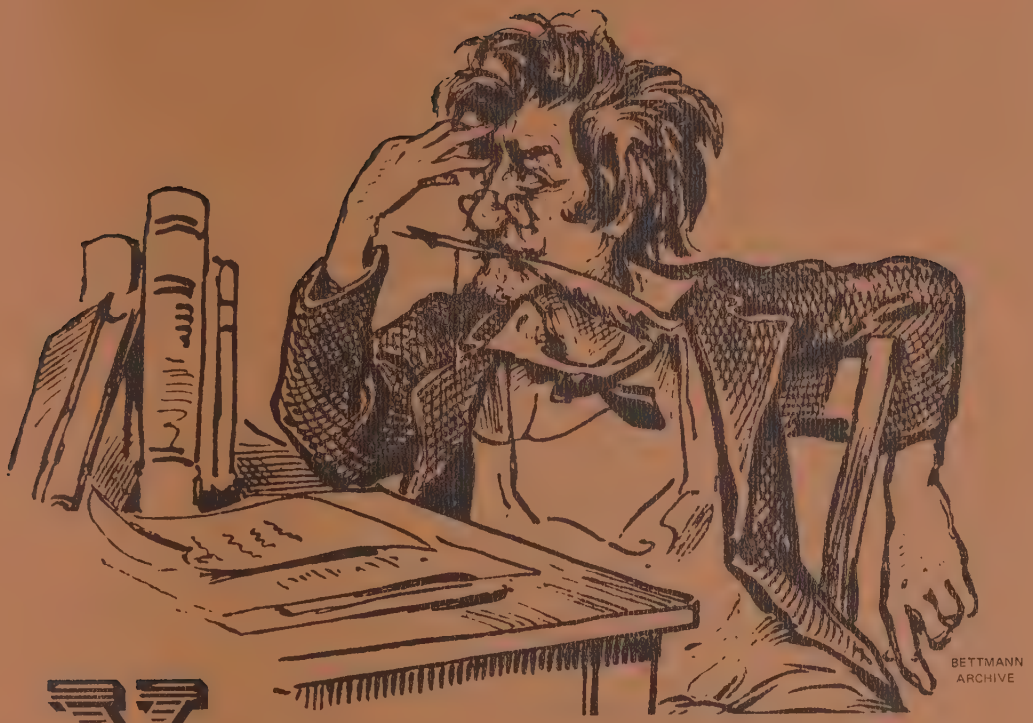
3.2.1 RECYCLE RATE CONTROL -- turns power on and off and sets counter display time from 0.2 to 5 seconds. When positioned at infinity, the counter displays the last measurement indefinately or until the RESET pushbutton is depressed.

3.2.2 GATE INDICATOR -- lights for the duration of the measurement interval (gate). It provides a positive instrument-is-counting indication, especially when the STORAGE ON display mode is selected.

3.2.3 FUNCTION SWITCH

1) PERIOD -- measures time of one to 10^5 periods (in decade steps) of the input waveform.

2) RATE -- measures frequency by counting each input cycle during a selected time base period, 10 millisecs to 10 seconds in decade steps. This switch also controls the automatic decimal point and units-of-measure indicators.



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3) COUNT -- totalizes the number of cycles applied to the INPUT BNC.

4) HOLD -- an extension of the COUNT mode. When HOLD is initiated, the COUNT function ceases and the counter retains and displays the accumulated count. When the COUNT mode is again selected, the counter continues to totalize from the point at which HOLD was initiated.

3.2.4 READOUT INDICATORS -- consist of seven (options to nine) numerical indicator tubes and an automatically positioned decimal point.

3.2.5 INPUT ATTENUATOR -- selects attenuation networks which will decrease input signal amplitude by a factor of 10 or a factor of 100. The TEST position provides a convenient means of self-testing the counting circuits.

3.2.6 TRIGGER LEVEL CONTROL -- is used to select a dc voltage level which will produce consistent triggering of the counting circuits. The PRESET position centers the trigger level, automatically, at zero cross-over.

3.2.7 ANNUNCIATOR ASSEMBLY -- indicates units-of-measure in kHz, MHz, µs and OS (off scale).

3.2.8 AC-DC SWITCH -- permits ac or dc coupling of the input signal. The AC position, via .1 µfd capacitor in series with the INPUT connectors, ac couples the input signal to the counter's input amplifier.

3.2.9 INPUT CONNECTOR -- accepts an input signal (front panel).

3.2.10 RESET PUSHBUTTON -- manually resets the counter to zero. When this switch is pushed, the counter first resets to zero and then begins its next counting cycle.

REAR PANEL

3.2.11 115v/230v LINE SWITCH -- adapts the SD 7014 to either a 115V ac or 230V ac primary power source. Do not apply 230 ac to the unit with this switch in the 115V position.

3.2.12 STORAGE ON/OFF SWITCH -- allows the SD 7014 to hold and display the last measurement taken until the next measurement-interval (ON position). In the OFF position, storage is defeated and the display constantly updates itself.

3.2.13 INPUT CONNECTOR -- accepts an input signal (rear panel).

3.2.14 RESET CONNECTOR -- allows the counter to be reset remotely by a contact closure to ground. See "Reset", Paragraph 1.5.

3.2.15 BCD OUTPUT CONNECTOR (optional) --provides the display-readout information in binary coded decimal form for use with peripheral equipment.

3.2.16 NORM/TIM SWITCH -- permits time interval measurements to be made by the counter (TIM position). The TIM position, essentially, instructs the counter to count 1 MHz for a certain time interval, determined by the two signals applied to the START BNC and the STOP BNC. See Paragraph 1.5, under Time Interval Measurements. All

counter functions, other than TIM, are accomplished with the NORM/TIM switch in the NORM position.

3.2.17 INT-EXT ONE MHz SWITCH -- supplies a 1 MHz counter output signal, (derived from the internal time base) to the 1 MHz BNC (INT position) or accepts an external 1 MHz time base input at 1 MHz BNC (EXT position).

3.2.18 FREQ. ADJ. (Coarse, Fine) -- are used to adjust the internal time base oscillator frequency to 1 MHz. See the Maintenance-Calibration Chapter 4 for more detailed information.

3.3 ACCURACY OF MEASUREMENT

If the SD 7014 is to be used to make critical measurements, several factors which may cause errors in counter measurements must be considered. The following paragraphs will illustrate most types of counter errors and present practical solutions to problems created by such errors.

3.3.1 Oscillator Stability

Digital frequency measurements are subject to several types of errors. One of the most significant is inaccuracy of the timing interval, as determined by stability of the crystal-controlled oscillator. The three commonest causes of oscillator instability are the oscillator's inherent aging rate (usually 1 part in 10^6 to 5 parts in 10^{10}), operation temperature variations, and line (supply) voltage fluctuations.

Errors due to oscillator instability may be reduced by the following techniques:

1) By leaving the counter on all the time. The aging rate of an oscillator is greatest when it is first turned on. As an example, the high stability oscillator available for Systron-Donner counters has an aging rate of 1 part in 10^9/day after 30 hours continuous operation. After 60 days continuous operation, the aging rate improves to 3 to 4 parts in 10^{10}/day.

2) By frequent calibration with a frequency standard (periodic comparison against a primary frequency standard allows the oscillator to be corrected for drift.

3) By substitution of an external oscillator in place of the standard internal oscillator. If an oscillator with better stability than that of the counter is readily available, it should be used.

3.3.2 Gating Error

Gating error is responsible for a possible error of ±1 count (in the least significant digit of the display) in almost all types of counter measurements. This error is possible because the incoming signal passing through the count gate is not synchronized with the time base pulses which control the gate.

As demonstrated in Figure 3, the first or last cycle of the input signal may or may not pass through the gate during the selected measurement interval.

For high frequency measurements, the ±1 count gating error is insignificant compared to the total count. At low frequencies, however, the error may become important. For this reason, the period mode of measurement is normally used to obtain greater accuracy. Figure 4 shows which type of measurement will yield the lowest gating error.

Gating error can be reduced by a factor of 10 by extending the interval of measurement (Period x 10, etc.). The total count is multiplied by ten but the gating error remains ±1 count.

For example, if a 10 kHz is measured over a 0.1 second time base, the count indicated would be 1000 ±1 and the percentage of error would be ±0.1%. Measured over a 1 second time base, the count indicated would be 10,000 ±1 and the percentage of error would be reduced to ±0.01%.

3.3.3 Count Error Produced by Noise in Frequency Measurements

Noise superimposed on the input waveform may cause spurious count pulses to appear at the output of the input amplifier, which might then be counted. If this should happen, an output pulse occurs, and is counted, each time the input signal crosses and re-crosses the selected amplifier trigger voltage level, as shown in Figure 5. Since an input signal cycle must usually have amplitude of at lease 0.2 to 0.3 volts p-p to cause triggering, spurious counts can be eliminated by attenuating the total "input pulse noise" signal to a suitable amplitude.

It is important to have both attenuator and trigger level controls set properly when measuring signals under marginal conditions of noise.

3.3.4 Loading Error

One frequently overlooked and generally not significant error may occur if the connection of the instrument to the external signal causes a frequency or amplitude shift of the external signal.

This error will only be noticed with signal sources of relatively high impedance (high frequency signals) in comparison to the input impedance and frequency rating of the counter.

For signals of sufficient amplitude, the loading error can be reduced by placing either a small coupling capacitor or a large resistor in series with the input signal. The isolating component should be located at the signal source so that it will also isolate the cable capacity.

The loading caused by connecting the input impedance to the start and stop channels of a specific signal source, can be calculated to determine if the source of error is significant. For example, if a counter with a 10 megohm input impedance is used with a signal source having a 10,000 ohm output impedance, the effective value of this resistor is changed by approximately 0.1%. This would be equivalent to shifting the phase of a 60 cycle signal by approximately 0.23 degrees.

3.3.5 Trigger Error

In addition to gating error, oscillator drift and loading errors, the Period and related Time Interval Measurements are subject to a trigger time error caused by noise on the input signal.

The total signal may be considered as an ideal noise free signal with a superimposed noise signal. The noise added to the ideal signal may trigger the channel before or after the selected instant for triggering. The maximum error in time for a given p-p noise voltage (Vn) and the slope of the ideal signal at the trigger level is:

$$t\ (\text{sec}) = \frac{Vn \quad (\text{volts})}{\text{Slope} \quad (\text{volts/sec})}$$

The maximum percent error is

$$\text{Max} \qquad \text{Max. \% error} = \frac{t \times 100 \quad (\text{sec})}{T \quad (\text{sec})}$$

For a sine wave triggering at its zero cross-over point:

$$\text{Max. \% error} \pm \frac{Vn \times 100\ (\text{volts})}{Vs \quad (\text{volts})}$$

This error effectively lengthens or shortens the period measurement as depicted in Figure 6. The percentage of error is given by the formula 100/T, where T is the actual period and is the trigger error (in seconds).

From the foregoing discussion, it can be seen that as the amplitude of signal voltage is increased, the percentage of error is diminished

In addition, if the trigger level is set at the center of the steepest slope of the waveform, the maximum error will be reduced.

Another way to reduce trigger error is to measure multiple periods of the gating signal. Since this error occurs only with the first and last pulses of the measuring interval, the trigger error will be reduced by a factor of 1/M if the measurement is extended for M periods.

The various errors add up in the following manner (as depicted in Table 2) to form the total error for each of the functions.

TABLE 2 TOTAL ERROR

FUNCTION	ERRORS PRESENT
RATE	GATING + DRIFT + LOADING
PERIOD & TIME	GATING + DRIFT + TRIGGER + LOADING
RATIO & GATE	GATING + TRIGGER + LOADING

3.4 EQUIPMENT OPERATION

The following paragraphs explain the functional operation of the counter. All of the following operating procedures have a "counter ON and warmed up" prerequisite.

3.4.1 Test Function

1) Place the ATTENUATOR switch in the TEST position.

2) Turn RECYCLE RATE control fully counter-clockwise, but not OFF (minimum display time).

3) Turn STORAGE switch ON.

4) Place INT-EXT switch in INT (internal) position.

5) Beginning with 10^{-2} (100 Hz), place the FUNCTION switch in each of its "time base" (RATE) positions. Observe that the indications are as shown in Table 2 -- agreement with Table 2 signifys fully operational counting circuitry.

TABLE 3

Function Switch Position	Correct Indication
100 Hz (10 ms time base)	001.0000 MHz
10 Hz (100 ms time base)	01.00000 MHz
1.0 Hz (1 sec time base)	1000.000 kHz
0.1 Hz (10 sec time base)	(1) 000.0000 KHz OS
0.1 Hz (8 digit readout)	1000.0000 kHz
0.1 Hz (9 digit readout)	01000.0000 kHz

1) Set the FUNCTION switch to the RATE position which will result in the desired resolution. See Table 4.

3.4.2 Frequency (RATE) Measurements

1) Set the FUNCTION switch to the RATE position which will result in the desired resolution. See Table 4.

TABLE 4

RESOLUTION ↑				
↓	10 ms	100 ms.	1 sec.	10 sec.
	100 Hz.	10 Hz.	1 Hz	0.1 Hz.

← FUNCTION SWITCH RATE POSITION →

2) On the rear panel, set the INT-EXT switch to INT. Set the STORAGE switch as desired.

3) If the amplitude of the frequency to be measured is known, set the ATTENUATOR switch as follows: If the input amplitude is between 0.1V and 1.0V p-p, set range to 10; if above 1.0V set range to 100.

CAUTION: the counter will not operate properly with input signals above 150V peak-to-peak and signals greater than .250V, P-P will damage the instrument.

If the amplitude of the signal to be measured is unknown, place the ATTENUATOR switch to 100. Perform Step 4, then decrease the attenuation range until correct operation is observed.

4) Apply the signal to be measured to either INPUT connector.

5) Set the AC-DC switch as desired.

6) Rotate the TRIGGER LEVEL control until a stable count is observed on the indicators. If no count is observed place the ATTENUATOR switch in the next lower range.

NOTE: It is normal for the less significant digits to fluctuate. Most input signals will have enough instability to cause some variation.

3.4.3 Count (Totalize) Measurements

1) Set the ATTENUATOR switch as in Paragraph 3.4.2 step 3.
2) Apply signal to be counted to either INPUT connector.
3) Place the AC-DC switch as desired.
4) Put the FUNCTION switch to COUNT.
5) Rotate the TRIGGER LEVEL control until the indicators begin to cycle (the storage feature is automatically defeated in COUNT).
6) If the count is to begin at a particular point in time, place the FUNCTION switch in HOLD (which stops the count), depress the RESET momentary pushbutton (which sets the indicators to zero), and then return the FUNCTION switch to COUNT at the desired "start" time.

3.4.4 Hold Function

1) Set the FUNCTION switch to HOLD -- the count will stop and remain displayed. The count may be set to zero by initiating reset, either remotely or with the RESET pushbutton.
2) To resume the count or start a new count, return the FUNCTION switch to COUNT.

3.4.5 Time Interval Measurements

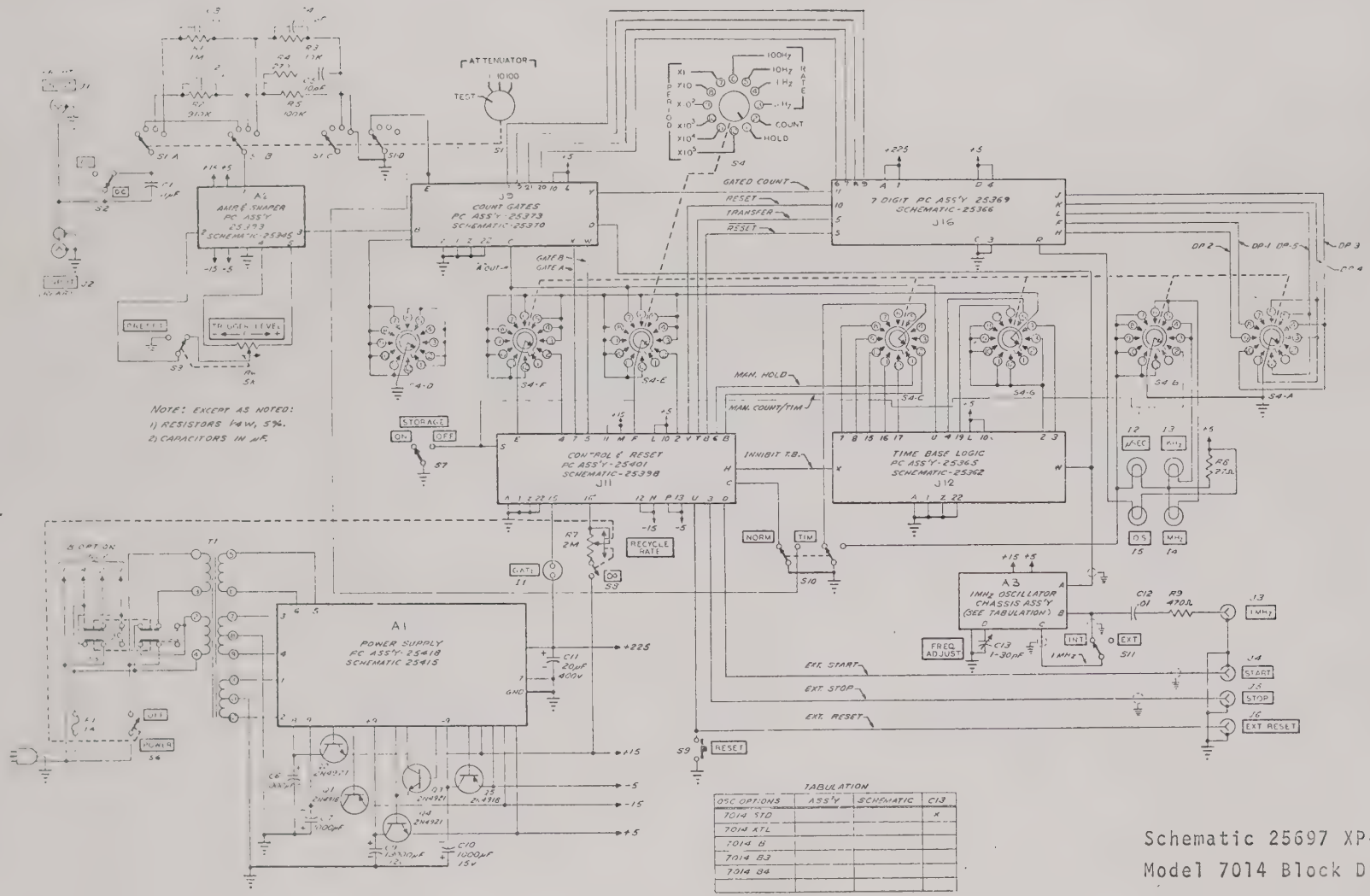
1) Set the FUNCTION switch to the COUNT position.
2) Place the NORM/TIM switch in the TIM position.
3) Apply acceptable start and stop signals (see Paragraph 1.5, and Time Interval Measurements Inputs section) to the START and STOP input BNC connectors.
4) Be sure the NORM/TIM switch is in the NORM position for all functions except time interval measurement.

3.4.6 Period Measurements

1) Set the FUNCTION switch to the desired PERIOD position.
2) Set the ATTENUATOR switch as in Paragraph 3.4.2, Step 3.
3) Set the AC-DC switch as desired.
4) Apply the signal to be measured to either INPUT connector.
5) Rotate the TRIGGER LEVEL control until a stable indication is displayed. If no indication is displayed, select the next lower ATTENUATOR switch range positon. Should the indication be unstable, check the frequency,amplitude, and stability of the input signal.

3.4.7 Ratio Measurements

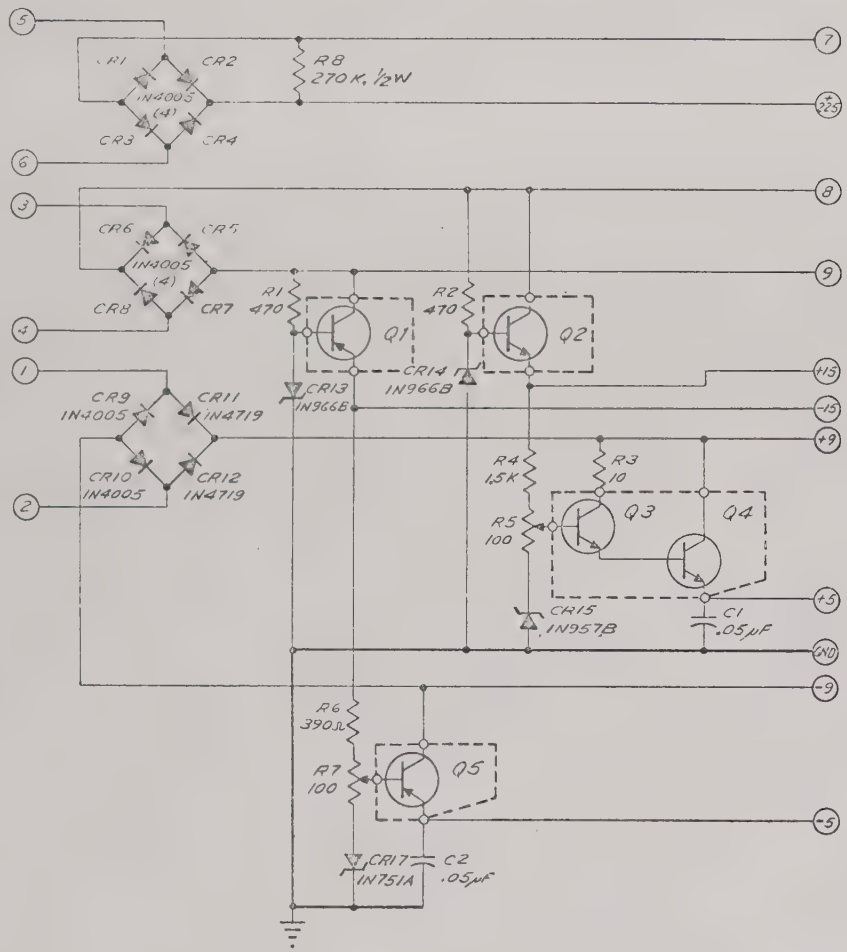
1) Set FUNCTION switch to the PERIOD position which provides the desired resolution.
2) Place the INT-EXT switch to EXT.
3) Apply the f_1 signal input, 1 kHz to 2 MHz, to the 1 MHz BNC connector.
4) Apply the f_2 signal input, 0 to 5 MHz, to either INPUT connector.
5) Adjust TRIGGER LEVEL control for most stable indication. The counter indication will be the ratio between f_1 and f_2. times PERIOD position multiplier.



TABULATION

OSC OPTIONS	ASS'Y	SCHEMATIC	C13
7014 STD			X
7014 XTL			
7014 B			
7014 B3			
7014 B4			

Schematic 25697 XP-3
Model 7014 Block Diagram

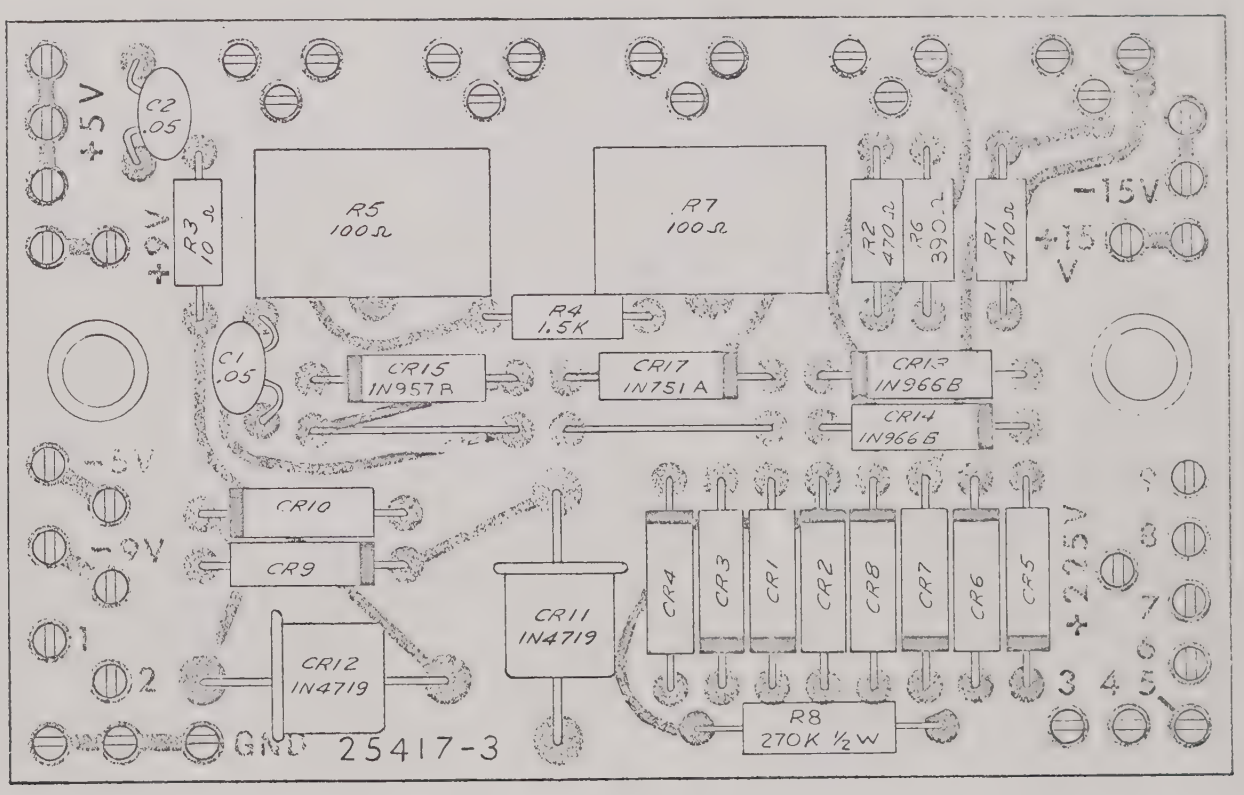


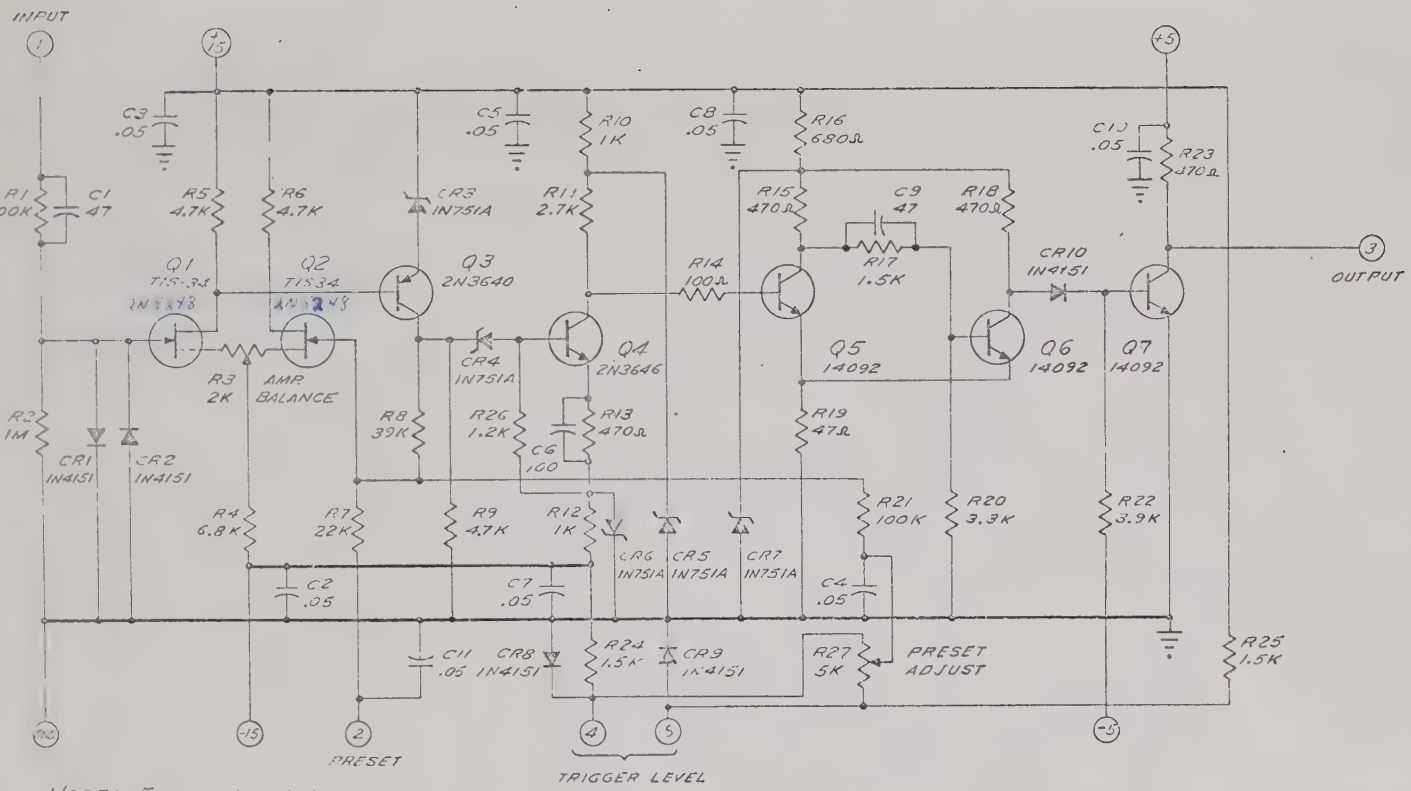
NOTE:
EXCEPT AS NOTED:

1) RESISTORS:
   POWER - ¼W.
   TOL - - 5%.

2) TRANSISTORS (REF):
   Q2, Q3 & Q4 ARE 2N4921.
   Q1 & Q5 ARE 2N4918.

Schematic 25415 XP-3
Power Supply PC Assembly


+5V
C2 .05
+9V
R3 10Ω
R5 100Ω
R7 100Ω
R2 470Ω
R6 390Ω
R1 470Ω
-15V
+15 V
R4 1.5K
C1 .05
CR15 IN957B
CR17 IN751A
CR13 IN966B
CR14 IN966B
-5V
-19V
CR10
CR9
CR11 IN4719
CR4
CR3
CR1
CR2
CR8
CR7
CR6
CR5
+225V
CR12 IN4719
R8 270K ½W
GND
25417-3
1
2
3
4
5
6
7
8
9
10

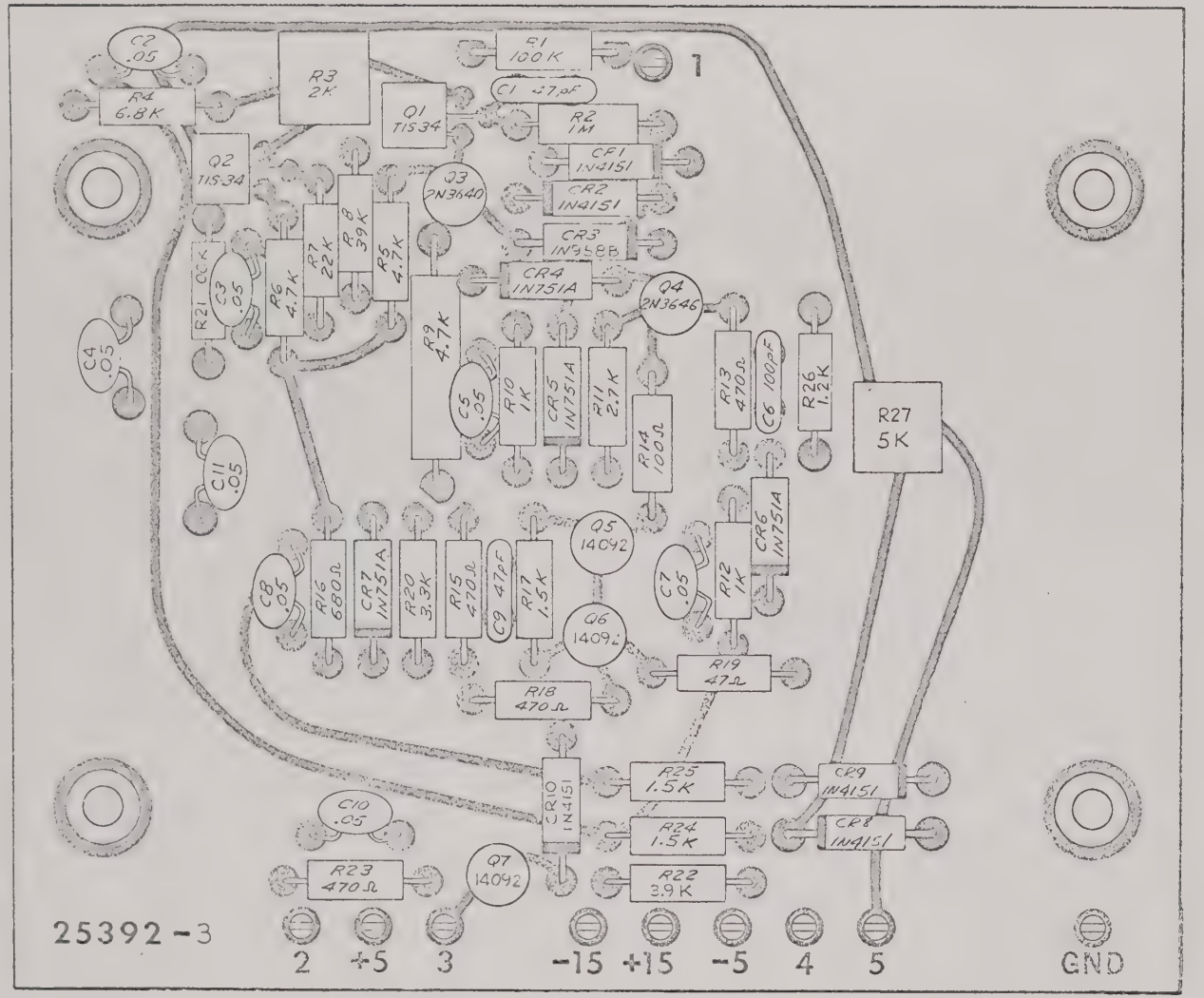


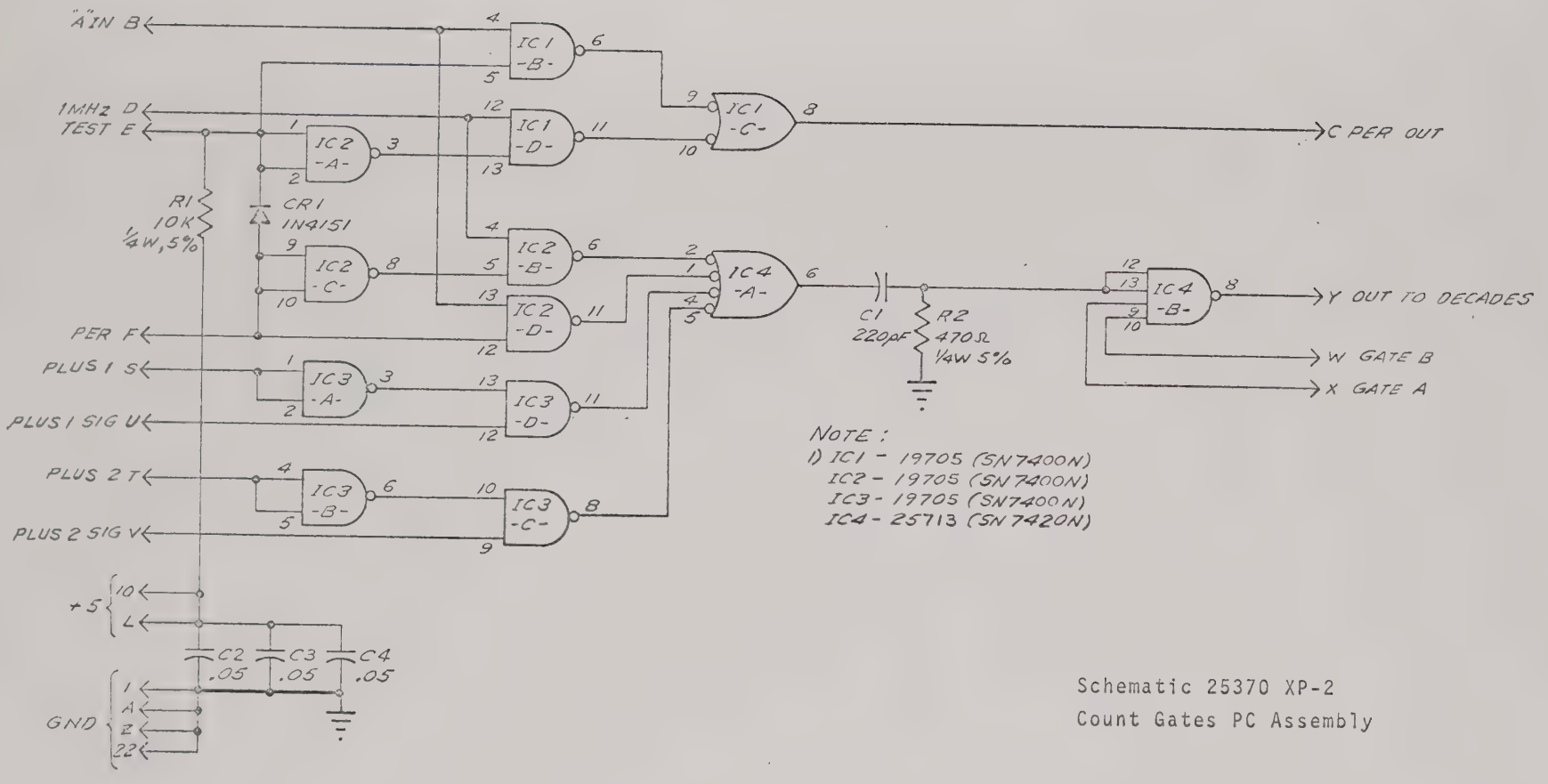
NOTE: EXCEPT AS NOTED.

1) RESISTORS:
   POWER ——— 1/4 W.
   TOL. ——— 5%.

2) CAPACITORS:
   MORE THAN ONE IN pF.
   LESS " " " μF.

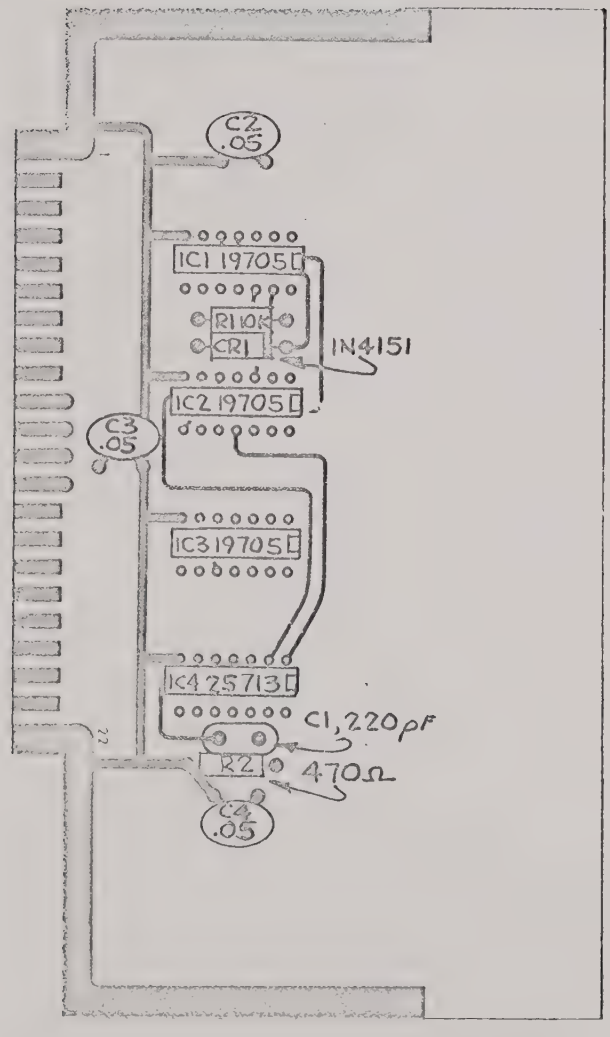
Schematic 25345 XP-3
Amp. and Shaper PC Assembly

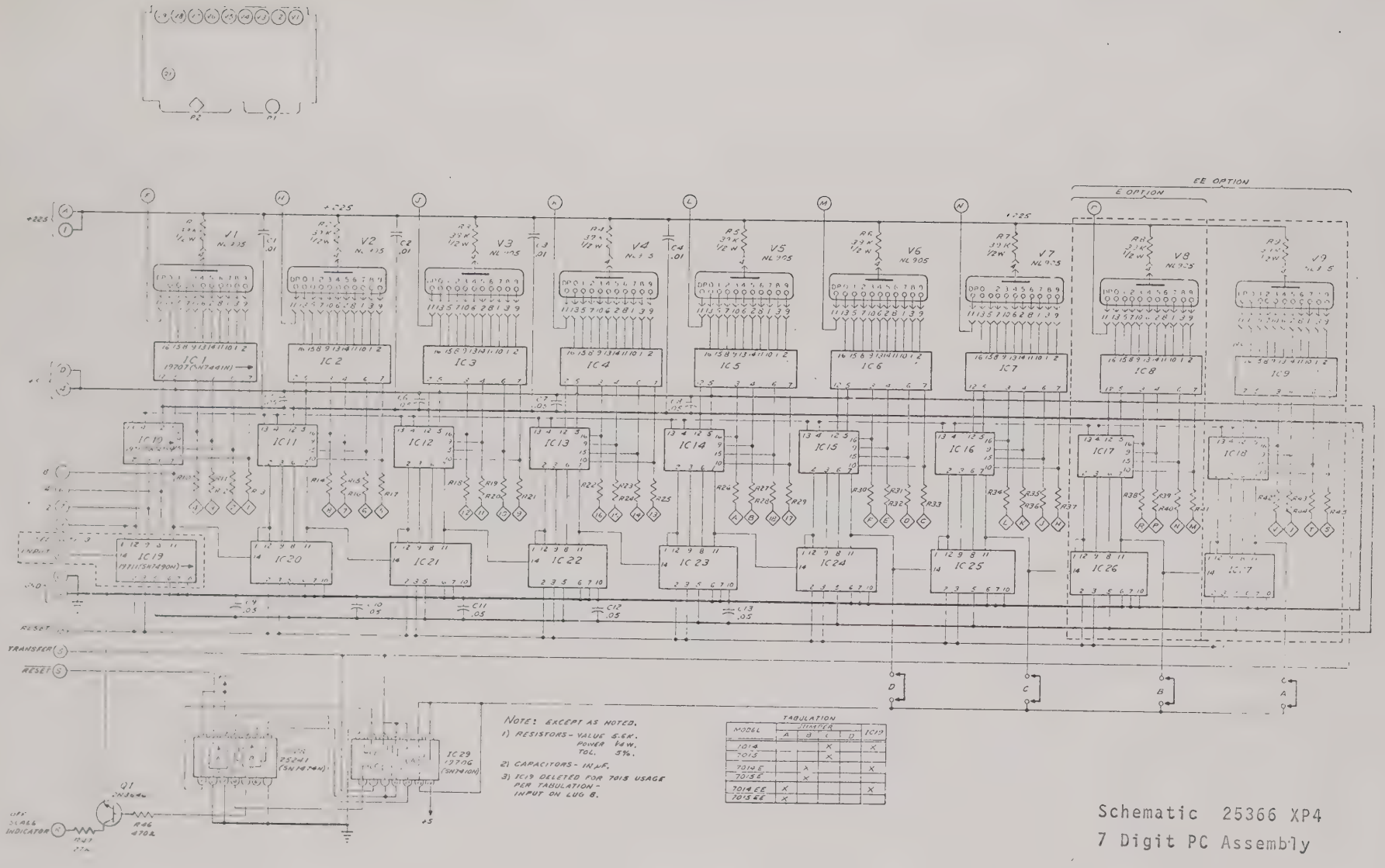

C2 .05
R4 6.8K
R3 2K
Q1 T1534
P1 100K
C1 47pF
R2 1M
1
CR1 IN4151
CR2 IN4151
CR3 IN958B
CR4 IN751A
Q2 T1534
Q3 2N3640
R8 39K
R7 22K
R5 4.7K
R6 4.7K
R21 CCW
C3 .05
R9 4.7K
C5 .05
R10 1K
CR5 IN751A
R11 2.7K
R14 100Ω
Q4 2N3646
R13 470Ω
C6 100pF
R26 1.2K
R27 5K
C4 .05
C11 .05
Q5 14092
Q6 14092
R16 680Ω
CR7 IN751A
R20 3.3K
R15 470Ω
C9 47pF
R17 1.5K
C8 .05
C7 .05
R12 1K
CR6 IN751A
R19 47Ω
R18 470Ω
CR10 IN4151
R25 1.5K
R24 1.5K
R22 3.9K
CR9 IN4151
CR8 IN4151
C10 .05
R23 470Ω
Q7 14092
25392-3
2
+5
3
-15
+15
-5
4
5
GND



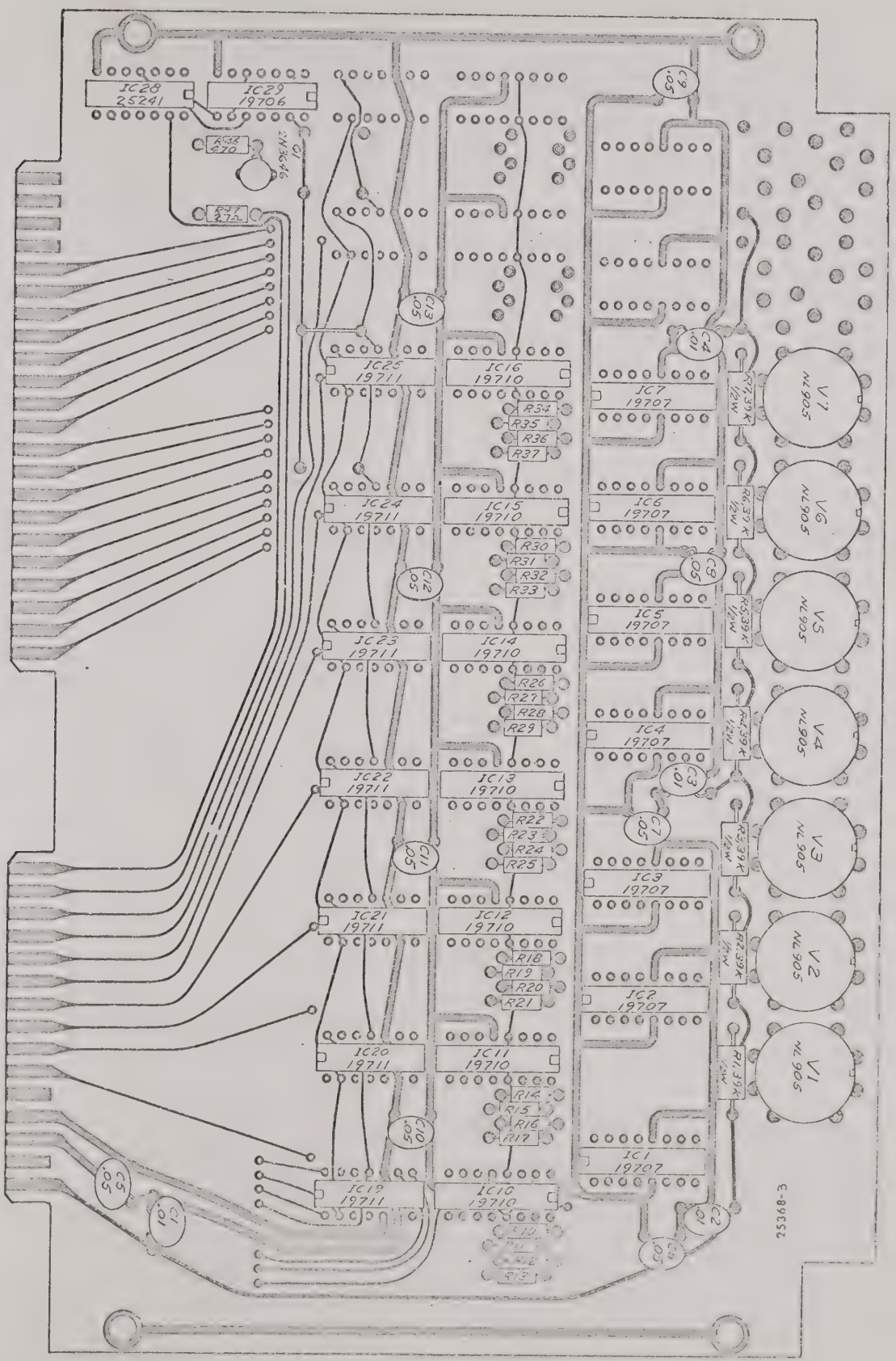
NOTE:
1) IC1 - 19705 (SN7400N)
IC2 - 19705 (SN7400N)
IC3 - 19705 (SN7400N)
IC4 - 25713 (SN7420N)

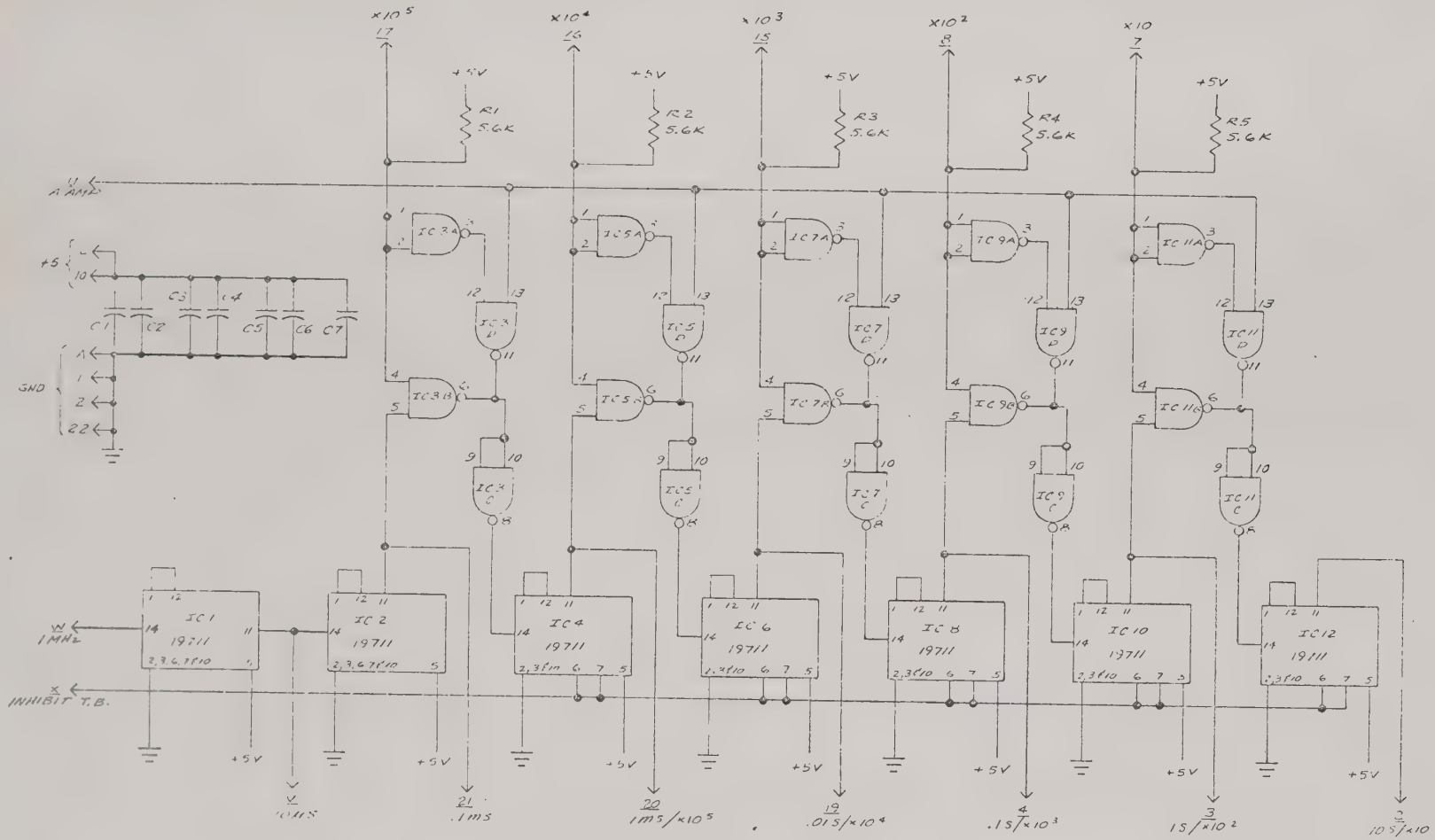
Schematic 25370 XP-2
Count Gates PC Assembly


C2
.05
IC1 19705
R1 10K
CR1
IN4151
IC2 19705
C3
.05
IC3 19705
IC4 25713
C1, 220pf
R2
470Ω
C4
.05



Schematic 25366 XP4
7 Digit PC Assembly


IC28 25241
IC29 19706
Q1 2N3646
R34 270
R35 270
IC25 19711
IC16 19710
IC7 19707
R34
R35
R36
R37
IC24 19711
IC15 19710
IC6 19707
R30
R31
R32
R33
IC23 19711
IC14 19710
IC5 19707
R26
R27
R28
R29
IC22 19711
IC13 19710
IC4 19707
R22
R23
R24
R25
IC21 19711
IC12 19710
IC3 19707
R18
R19
R20
R21
IC20 19711
IC11 19710
IC2 19707
R14
R15
R16
R17
IC19 19711
IC10 19710
IC1 19707
C13 .05
C12 .05
C11 .05
C10 .05
C9 .05
C8 .05
C7 .05
C6 .01
C5 .05
C4 .01
C3 .01
C2 .01
C1 .01
R7 1.39K 1/2W
R6 1.39K 1/2W
R5 1.39K 1/2W
R4 1.39K 1/2W
R3 1.39K 1/2W
R2 1.39K 1/2W
R1 1.39K 1/2W
V7 NL 905
V6 NL 905
V5 NL 905
V4 NL 905
V3 NL 905
V2 NL 905
V1 NL 905
25368-3



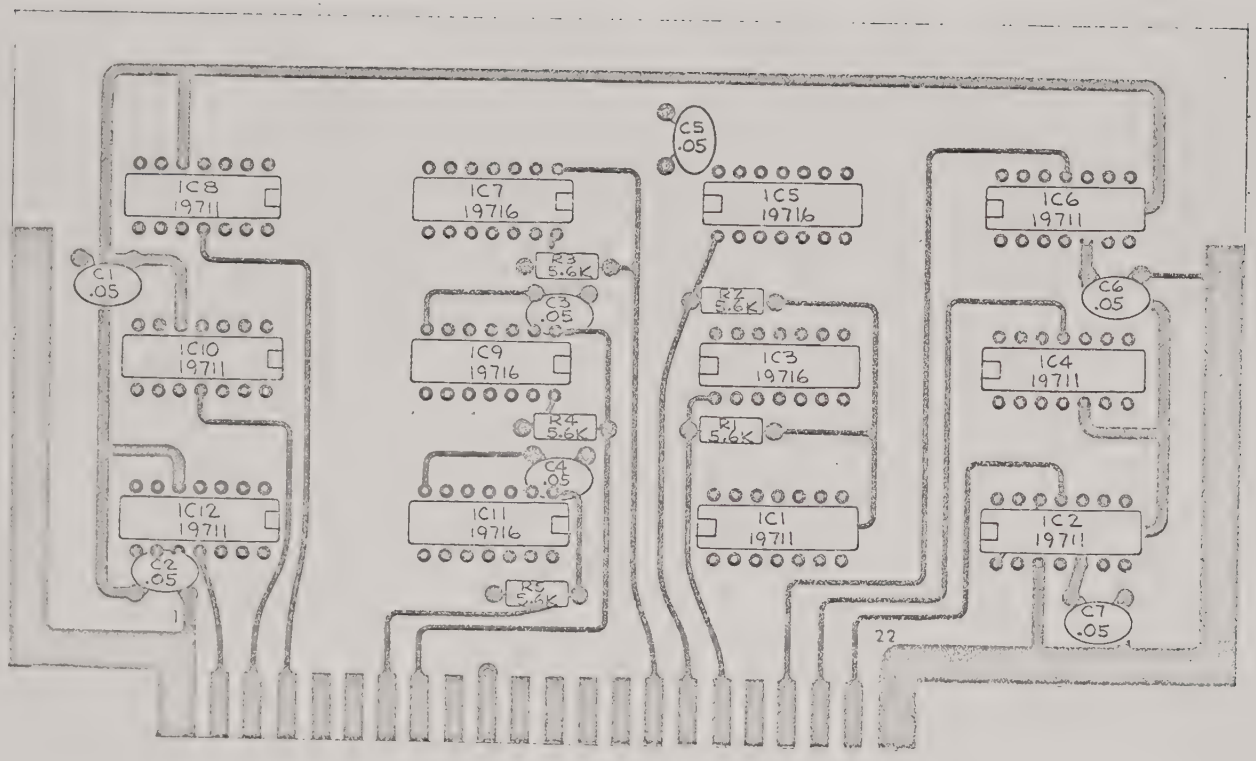
NOTE:

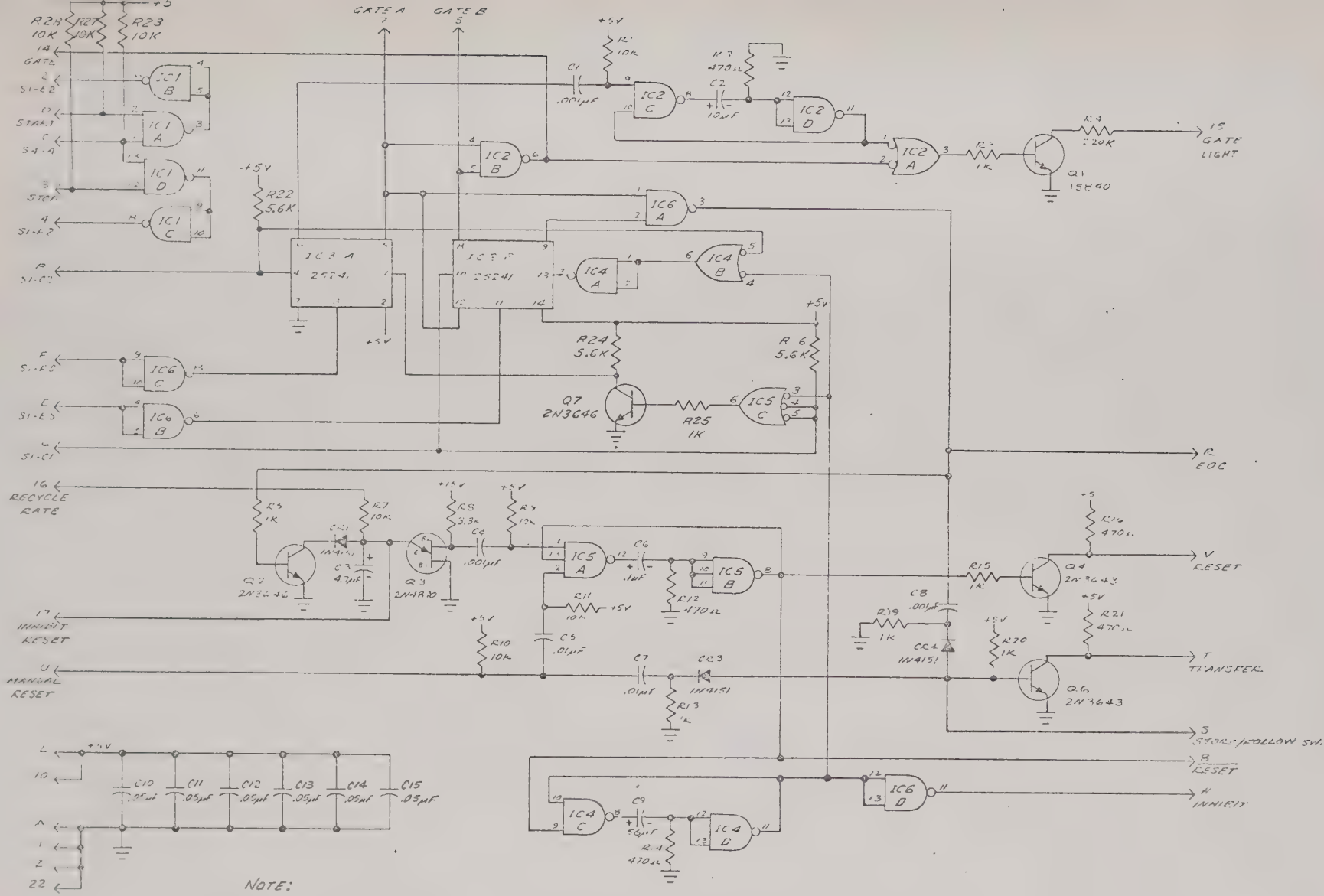
1) RESISTORS:
   POWER - 1/4 W.
   TOL - -5%

2) CAPACITORS:
   VALUE - .05 μF.
   VOLTAGE - 12V.

3) IC3, IC5, IC7, IC9 & IC11 ARE 19716
   PIN 14 IS + 5.
   PIN 7 IS GND.

Schematic 25362 XP-3
Time Base Logic PC Assembly


IC8
1971
IC7
19716
C5
.05
IC5
19716
IC6
1971
C1
.05
R3
5.6K
R2
5.6K
C6
.05
C3
.05
IC10
1971
IC9
19716
IC3
19716
IC4
1971
R4
5.6K
R1
5.6K
C4
.05
IC12
1971
IC11
19716
IC1
1971
IC2
1971
C2
.05
C7
.05
1
22

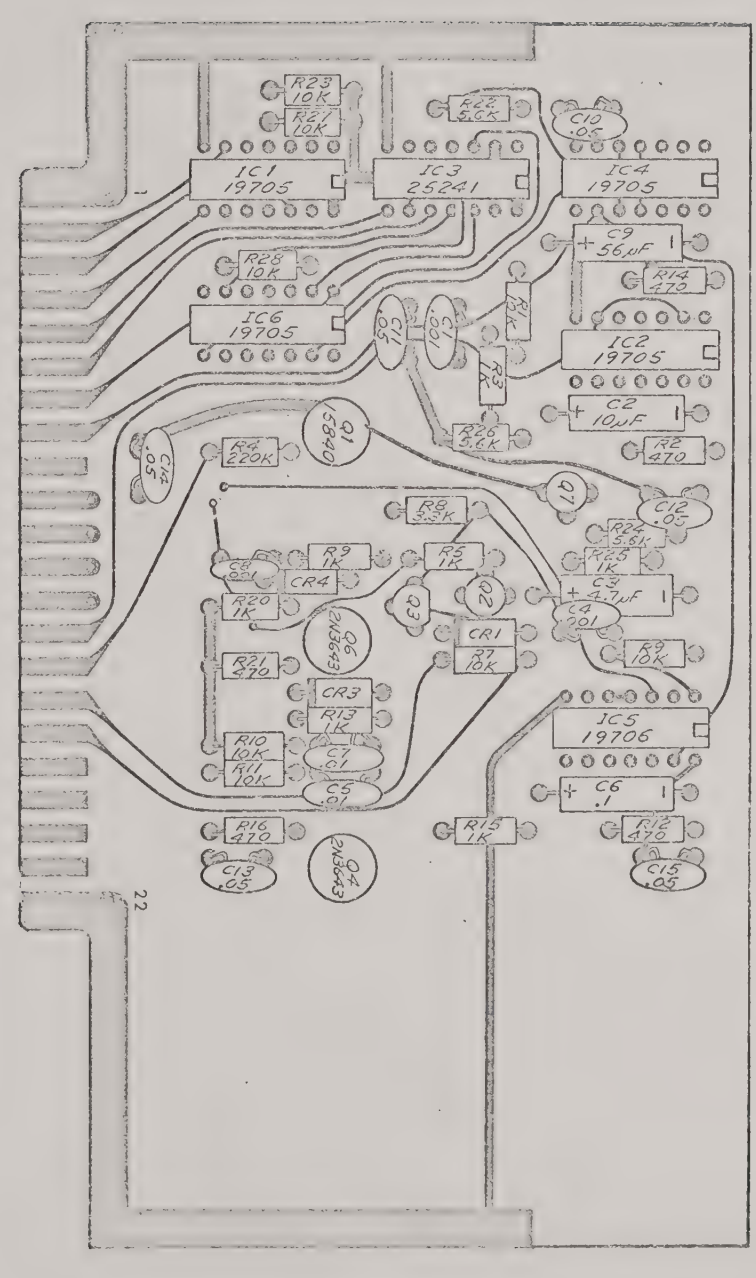


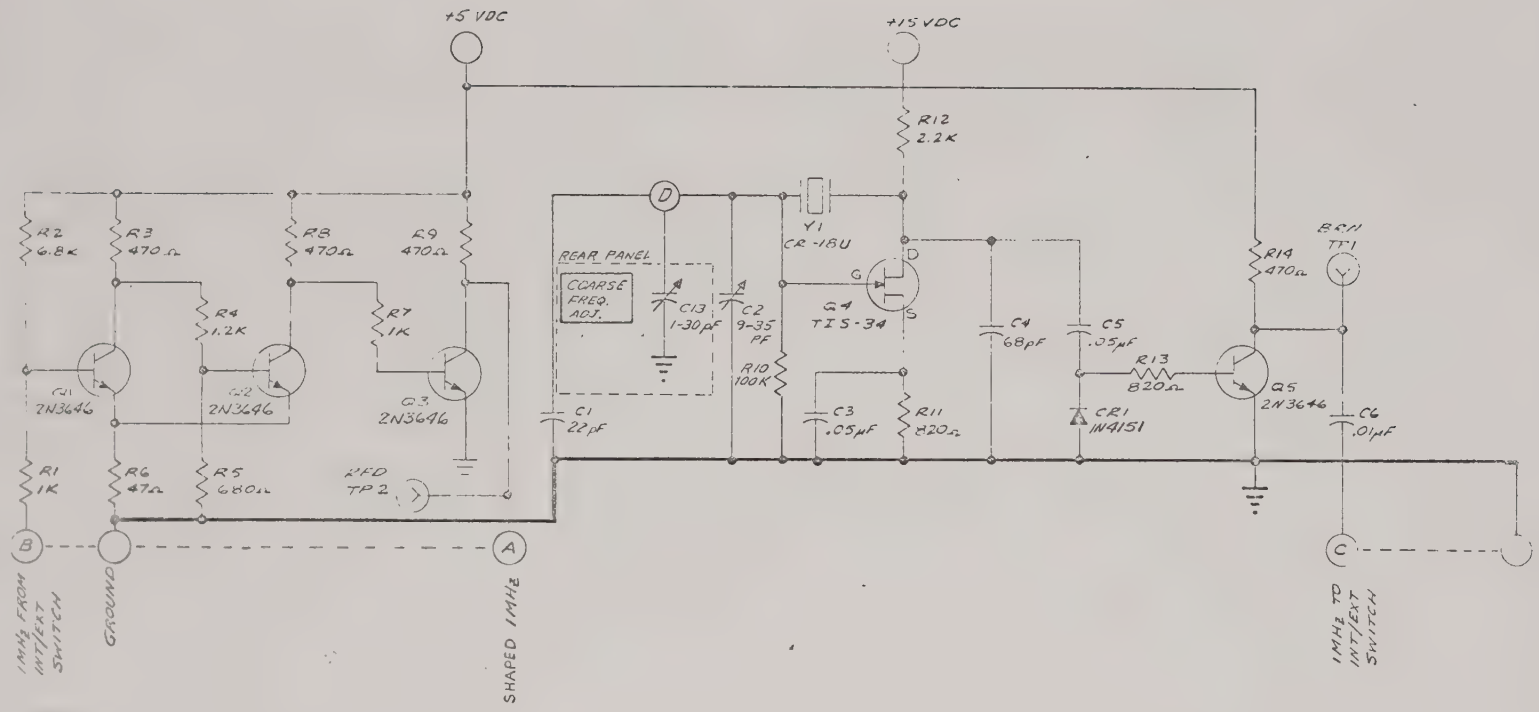
NOTE:

1) IC1 - 19705, GND - PIN 7, +5V - PIN 14.
IC2 - ↓
IC4 - ↓
IC5 - 19706
IC6 - 19705

2) RESISTORS - 1/4W, 5%.

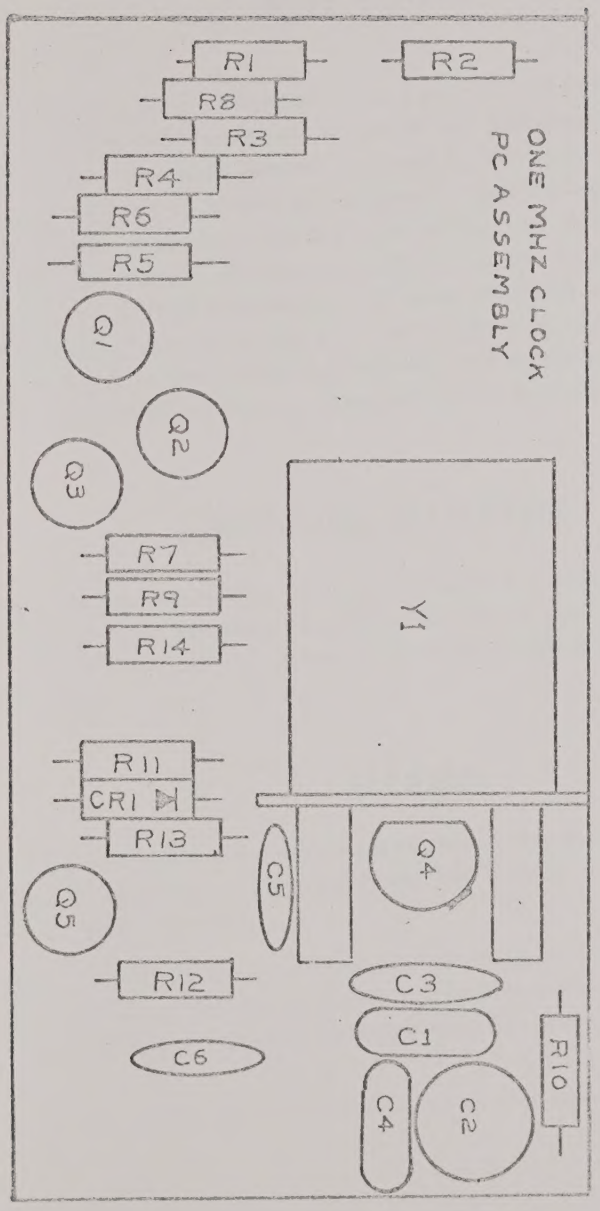
Schematic 25398 XP-4
Control and Reset PC Assembly


R23 10K
R24 10K
R22 5.6K
C10 .05
IC1 19705
IC3 25241
IC4 19705
C9 56μF
R14 470
R28 10K
IC6 19705
C11 .05
C10 .05
R1 1K
R3 1K
IC2 19705
C2 10μF
R2 470
R26 5.6K
Q1 2N5840
C14 .05
R4 220K
Q1
C12 .05
R8 3.3K
R24 3.3K
R25 1K
C3 4.7μF
C4 .01
R9 10K
R9 1K
R5 1K
C8 .01
CR4
R20 1K
Q3
Q2
Q6 2N3643
CR1
R7 10K
R21 470
CR3
R13 1K
IC5 19706
R10 10K
R11 10K
C7 .1
C1 .01
C5 .01
C6 .1
R16 470
R15 1K
R12 470
C13 .05
Q4 2N3643
C15 .05



NOTE.
UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE ±5%, 1/4 W

Schematic 25670 XP-2
1 MHz Clock PC Assembly


R1
R2
R8
R3
R4
R6
R5
ONE MHZ CLOCK
PC ASSEMBLY
Q1
Q2
Q3
R7
R9
R14
Y1
R11
CR1
R13
Q4
C5
Q5
R12
C3
C1
R10
C6
C4
C2

WARRANTY

Systron-Donner instruments are warranted during a period of one year from date of shipment to original purchaser to be free from defects in material and workmanship. This warranty does not apply to vacuum tubes, except as they are warranted by tube manufacturers. The liability of Seller under this warranty is limited to replacing or repairing any instrument or component thereof which is returned by Buyer at his expense during such period and which has not been subjected to misuse, neglect, improper installations, repair, alteration, or accident. Seller shall have the right of final determination as to the existence and cause of a defect. In no event shall Seller be liable for collateral or consequential damages. This warranty is in lieu of any other warranty, express, implied or statutory, and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

RECEIVING INSPECTION

Every Systron Donner instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as received. If the unit is damaged in any way or fails to operate, a claim should immediately be filed with the transportation company.

REPAIRS

Whenever a Systron-Donner instrument requires service, the nearest Systron-Donner representative should be contacted; all representatives will provide immediate service or arrange factory returns when necessary.

Please specify both model and serial number in all correspondence concerning Systron-Donner instruments. Address all inquiries on operation or applications to your nearest sales representative or Sales Manager, Instruments, Systron-Donner Corporation, 888 Galindo Street, Concord, California.

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